

Modern human origins inferred from nuclear genetic haplotype data. S.A. TISHKOFF(1), A.G. CLARK(1), J.R. KIDD(2), H. SOODYALL(3), T. JENKINS(3), and K.K. KIDD(2), (1) Department of Biology, Penn State University, University Park, PA (2) Department of Genetics, Yale University, New Haven, CT (3) Department of Human Genetics, SAIMR, WITS University, Johannesburg, South Africa.

Haplotypes consisting of highly stable RFLPs and insertion/deletion polymorphisms as well as more rapidly evolving STRPs have been examined in 1200-1600 individuals originating from a globally diverse set of 25 or more human populations at three nuclear loci [CD4, DM, PLAT]. The human polymorphisms were also examined in five non-human primate species to provide background for the inferences on the evolutionary processes that generated the haplotype diversity among modern human populations. Sub-Saharan African populations display high levels of haplotype diversity within each population and the haplotype frequencies differ considerably among populations, even between geographically close populations. Non-African populations have a subset of the haplotype diversity observed in Africa and a shared pattern of allelic association. Outside of Africa, haplotype diversity is highest in Eurasia and lowest in the Pacific Island and New World populations. The data from three independent loci are used to collectively make inferences about the demographic histories of African and non-African populations. Specifically, we used these data to examine the effects of differential gene flow, founder effect, population subdivision, and population expansion in generating population diversity. In addition, we used these data to test different hypotheses proposed for modern human origins. Results of these analyses support a recent African origin model of modern *H. sapiens* and suggest that Africans have maintained a larger effective population size and a more subdivided population structure relative to non-Africans.

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A scalloped trophy bone from an Epiclassic site in the Malpaso Valley, Zacatecas, Mexico. D.T.O. Arizona State University, Tempe, Arizona 85287-2402

Human trophy bones associated with burials usually refer to skulls, both worked and unworked, but long bones in the same context are rare, usually serving some utilitarian purpose before interment, such as rasps and wands. While not uncommon to many groups around the world, human trophy bones are most closely linked to Mesoamerica, but documentation of worked long bones as burial offerings has of yet been scarce.

This poster describes a worked human femur found within a disarticulated burial in the Epiclassic site of Los Pilarillos in the Malpaso Valley, Zacatecas, Mexico. Los Pilarillos is a contemporary subordinate village to the massive fortress-like ceremonial center of La Quemada. Once thought to be a Toltec outpost linking the Mesoamerican heartland with the American

Southwest, La Quemada's main occupation between AD 600-900 place it on the northern frontier of Mesoamerica as a pre-Toltec center of the valley's socio-political organization. Los Pilarillos, located 5 kilometers south of La Quemada is one of 220 other sites directly linked to La Quemada. Recent excavations at Los Pilarillos yielded a large multiple human burial, a flexed burial, and a disarticulated burial of a large adult male. Well preserved, the bones of the adult male could possibly have collapsed with time after initially being placed in a seated position, but discrepancies in their placement allow for other interpretations. Within this burial, was an adult femur, believed to be a trophy or an offering. This left femur, measuring 31 centimeters long, had its proximal end broken off just below the femoral head. The distal end was worked in a peculiar way in which the epiphysis was first broken off and then careful pressure was used to punch the remaining edge, resulting in a "scalloped" end. The inside of the femur was also thoroughly hollowed out of its cancellous bone, but only part way through from the distal end.

This trophy femur resembles a number of other long bones from La Quemada which exhibit the same pattern of modification. Along with femora scalloped on the distal end, an attempt at scalloping other femora at the proximal end as well as humeri, appeared to be unsuccessful.

While not as spectacular as skull racks or mass sacrifices, this worked femur and its connection to La Quemada have the potential to yield valuable insights on the complex sociopolitical organization of the area. Its proximity to Casas Grandes and the American Southwest place La Quemada in a vital location of the Mesoamerican frontier. Whether this scalloped femur was an offering to pay homage to supernatural beings or a trophy of a slain enemy, further bioarchaeological analysis of the valley's elaborate mortuary treatment is imperative in understanding La Quemada's role as a Mesoamerican ceremonial center.

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Variation Between and Within Three Chiribaya Populations: Anthropometric and Dietary Evidence. P.D. TOMCZAK¹, C.M. MALCOM², and J.E. BUIKSTRA¹. ¹University of New Mexico, Albuquerque, NM 87131; ²University of Chicago, Chicago, IL 60637

Genetic and dietary variation between and within three Chiribaya sites, located in the Osmore drainage of south-central Peru, are examined in this study. Whether dietary variation is mirrored in the genetic data is important in assessing whether biologically similar populations were also consuming similar resources.

Biological distances, expressed by Mahalanobis' D² values based on craniometric data, are used to assess patterns of human genetic variation. These distances are used to determine biological variation and population structure, including mating patterns and social movement between sites. This distance measure can also be used to assess male-female movement from site to site and changes in social relationships over time.

Variations in diet are assessed through the use of stable isotopes. Variation in geographical location and associated environmental conditions of the three Chiribaya sites is expected to have contributed to varying subsistence strategies and resulting diets. Differential consumption of resources is considered to be a reflection of various aspects of social identity such as occupation and trade networks. Conversely, evidence of access to resources from remote locations may reflect economic and social relationships within and between sites.

In order to assess the variation between the sample populations with respect to both dietary and genetic data, Mahalanobis' squared distance was used. Additionally,

the Mantel test was used to estimate the association between the genetic and diet matrices, and assess whether the association is stronger than one would expect from chance. Each data matrix is also compared to a temporal matrix in order to establish possible patterns of variation with respect to time.

After 1000 random permutations, results indicate no significant association between phenotypic relatedness and diet ($p > 0.05$). However, genetic distance is significantly associated with time ($p < 0.05$).

Heritability of bone mineral density in young to middle-aged adults.

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Recent studies of data from twins and nuclear family members (e.g., Takeshita et al. 1992 *Gerontology* 38:43; Jouanny et al. 1995 *Arthritis & Rheumatism* 38:61) have demonstrated a highly significant heritable component to individual variation in bone mineral density (BMD). Low BMD, especially when combined with loss of bone mineral content in old age, is a predisposing factor for the development of osteoporosis.

In this quantitative genetic study of total body BMD in young to middle aged adults, when BMD is at its peak following growth and development but has not yet started to significantly decline as a result of aging, we used a maximum likelihood method for pedigree data to estimate the heritability (h^2) of BMD in a sample of 391 white participants in the Fels Longitudinal Study (178 males and 213 females) aged from 18 to 50 years (mean age 33.2 years) who represent a total of 109 kindreds. Sex-specific regression terms for age and age² effects on BMD across this age range were simultaneously conducted in the analyses. Total body BMD was determined by dual x-ray absorptiometry (DXA) using a Lunar DPX system with software version 3.6z.

The h^2 estimate (\pm its standard error) of BMD in this sample was 0.92 ± 0.11 . Men had a significantly higher mean BMD than women (1.231 g/cm^2 vs. 1.166 g/cm^2), but in neither sex was there a significant decline in BMD from 18 to 50 years. These findings reveal that BMD has a very high heritability, and is essentially stable across this age range.

These findings hold promise that at least some of the genes accounting for major portions of the phenotypic variance in BMD may be able to be identified.

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The effect of osteon size and age at death on bone remodeling in Ancient Nubia. K.F. TRIVERS, Emory University, Atlanta, GA 30322

The relationship between osteon size and age at death (mean 34.8 years ± 13.3) to bone remodeling parameters was studied in a pilot investigation. Eight individuals (4 male, 4 female) representing an X-Group (NAX) population of Sudanese Nubia (350 - 550 CE) were studied.

Osteon counts were collected using a modification of Frost's (1966) "Triple-Surface-System" with 12 predetermined microfields representing the lesser trochanter of the femur. Remodeling rates were determined using Stout and Leuck's formulas (1995). The parameters studied were osteonal cross sectional area, netV_{frt} (net lifetime bone formation), murc (number of osteons created annually) and V_{frt} (annual bone formation rate).

The results were as follows: mean netV_{frt} was $0.664 \text{ mm}^3/\text{mm}^2$ (± 0.151), murc was $2.01 / \text{mm}^2/\text{yr}$ (± 1.84), and V_{frt} was $0.053 \text{ mm}^2/\text{mm}^2/\text{yr}$ (± 0.051). These variables were subsequently compared and correlated. Previous studies have elucidated the age factor to remodeling, which is confirmed by this study (R^2 is .767 for V_{frt}). Remodeling may also be related to mean osteon size; as osteon size increases, so do netV_{frt} , V_{frt} , and murc . Also, turnover may affect the ratio of the differing osteon types in an individual (i.e. percentage of double zonals vs. HDI bodies) and overall degree of mineralization present.

The relationship between osteon size and remodeling could be due to indirect forces such as biomechanics and/or activity patterns. These preliminary results indicate remodeling is a more dynamic process than previously thought.

Analysis of dental non-metrics and demography to determine familial use of four Hellenistic-Early Roman (325 BC-AD150) tombs in a rural inland site at Malloura, Cyprus. T.A. TUNG, University of North Carolina at Chapel Hill, NC 27599.

The assertion that Hellenistic-Early Roman populations from central Cyprus placed their dead in tombs based upon familial relatedness (Toumazou 1996) has limited archaeological support and no bioarchaeological evidence. Some support for this assertion comes from the Tomb of

the Kings' at Paphos, Cyprus, where it has been suggested that family lineages were buried together (Hunt 1982). However, it is not known if rural populations followed a similar style of burial practice. This paper uses dental non-metrics and demographic profiles to address this question.

Dental non-metric traits have shown to be largely genetically controlled, thereby offering an easily observable method to determine genetic (familial) relatedness of individuals within and between tombs. If each tomb was used by a specific familial line, then individuals within that tomb should be more biologically similar with each other than with the rest of the population. Furthermore, if family groups used specific tombs we should observe a demographic profile consisting of infants, children, and adults, and both males and females.

The MNI for the four tombs combined is 132 (n=1,026 teeth). Dental non-metrics were scored using the Arizona State University Dental Anthropology System. Individuals within each tomb are commingled, therefore, dental non-metric traits for isolated and intact teeth are compiled for each tomb and the overall population. Tomb group membership of skeletal elements are easily defined, as each of the four tombs are clearly separated. The dental data appear to be consistent with familial groupings, however, demographic data show an under representation of infants and children.

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evidence for chimpanzoid pedal traits. Indeed, some of them are false interpretations based on artifactual taphonomic features, reliance on a partial sample of the ≥ 27 first-generation casts of the Laetoli prints that we have studied, and her not accounting for the orientation of the prints on the trackway. For example, the ostensibly abducted hallucal impression in print G-1-34 was probably produced when the hallucal tip grooved the substrate during lift-off. A deeper impression of the hallucal pad is visibly aligned with that of the lateral toes, and the foot was dramatically out-toed, probably thereby causing the scuff mark.

Because the foot bones of Hadar *Australopithecus afarensis* evidence arboreally adapted features and the Laetoli hominid footprints are virtually humanoid, the latter should not be lumped with *A. afarensis*.

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Skeletal evidence for health in ancient Ecuador. D.H. UBELAKER, Department of Anthropology, NMNH, Smithsonian Institution, Washington, D.C. 20560 and L. NEWSON, Geography Department, King's College London, Strand, London WC2R 2LS U.K.

As part of the "History of Health and Nutrition in the Western Hemisphere" project, data were analyzed from 22 archeologically recovered samples of human remains from Ecuador to assess temporal and geographical patterns of health. Antiquity of the 724 individuals ranged from about 6,000 years ago to as recent as AD 1940. The samples were grouped into nine categories representing different time periods within the highland, north coast and south coast regions.

Analysis supports previous suggestions of deterioration of health with the advent of agriculture and increased population density/sedentism. Among the prehistoric samples, those from the highlands show less evidence of morbidity than those from coastal sites. Among the coastal samples, that from the north revealed higher frequencies of periosteal lesions and trauma but fewer dental problems and less evidence for other morbidity. Historic samples show increased evidence for dental disease and continuation of problems documented for earlier samples.

The data reported here suggest that geographical variation related to both climate and culture as well as temporal change contributes to the complex pattern of morbidity in ancient Ecuador. Overall, the samples from Ecuador suggest less morbidity than indicated for other areas of North America included in the project.

False Impressions from the Laetoli Hominid Footprints. R.H. TUTTLE and C. MUSIBA, Anthropology, University of Chicago, 1126 E. 59th St., Chicago, IL 60637-1587, D.M. WEBB, Sociology and Anthropology, Kutztown University, Kutztown, PA 19530, and B. HALLGRIMSSON, Anatomy, University of Puerto Rico, San Juan, PR 00936.

At the 66th annual meeting of the AAPA, Deloison (*Am. J. Phys. Anthropol.*, Suppl. 24: 101, 1997) argued that the 3.5-Ma hominid footprint trails at Laetoli Site G, northern Tanzania, were made by a creature with "arboreal feet," and elsewhere she has presented a more detailed case for chimpanzee-like feet on the Laetoli printmakers (*Origine(s) de la Bipédie chez les Hominidés, Cahiers de Paléanthropologie*, Y Coppens & B Senut (eds.), Editions du CNRS, Paris, pp. 177-186, 1991, and *C. R. Acad. Sci., Paris, Série II*, 315: 103-109, 1992).

Based on studies of the feet and footprints of bipedal apes and humans (Machiguengas and Hadzabe) with no history of wearing constraining footwear, we demonstrate that none of Deloison's 7 features of the Laetoli footprints is compelling

Incisor microwear and anterior tooth use in three Native American populations. P.S. UNGAR, Anthropology, University of Arkansas, Fayetteville, AR 72701 and M.A. SPENCER, Biological Anthropology and Anatomy, Duke University, Durham, NC 27710.

Researchers have suggested that unusual patterns of wear of the incisors of some fossil hominids can be explained by the use of teeth to prepare foods and to process non-food items. Still, little work has been done to determine how microscopic patterns of incisor wear correspond with differences in subsistence practices and anterior tooth use behaviors of modern peoples.

This study examines microscopic wear on the maxillary central incisors of three groups of humans: Aleutian Islanders ($n = 15$), Arikara from the Mobridge site ($n = 13$), and a late Woodland Bluff sample from Jersey County, Illinois ($n = 18$). High resolution replicas were prepared and examined by Scanning Electron Microscopy at 500x magnification. Photomicrographs were taken at consistent locations on the labial surfaces of these specimens and analyzed using Microware 3.0.

MANOVA tests on ranked data indicate significant variation among groups. Subsequent ANOVA and Bonferroni tests indicate the sources of variation. Groups differ in microwear feature densities, sizes and shapes. The Illinois Bluff sample has the highest mean feature density, the smallest features (in both length and width), and the highest mean feature length to width ratios. The Aleut sample is at the other extreme for these variables, and the Arikara are intermediate.

Differences between groups can best be explained by a combination of factors. Feature densities probably relate in part to subsistence practices, especially given that plants contain abrasive phytoliths whereas meat does not. Feature sizes and shapes evidently reflect the sizes and shapes of the abrasives causing the microwear, and perhaps the intensity of the forces with which the incisors contact those abrasives. For example, ethnographic accounts suggest that the Aleuts ate a lot of meat and loaded their incisors heavily. This is consistent with data presented here. Results of this study have important implications for analyses of incisor microwear in fossil hominids.

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Nursing patterns, maternal energetics, and postpartum fertility among Tobas of Formosa, Argentina. C.R. VALEGGIA and P.T. ELLISON, Reproductive Ecology Laboratory, Peabody Museum, Harvard University, Cambridge, MA 02138.

Lactational amenorrhea is the primary mechanism of natural birth spacing and fertility limitation in non-contracepting populations. Previous research has identified the temporal pattern of breastfeeding as an important factor modulating the duration of lactational amenorrhea and the pace of return to full fecundity postpartum. Recent research has suggested that maternal energetics, especially energy status and energy balance, and maternal age also contribute

significantly to the duration of lactational amenorrhea. This study investigates the respective roles of nursing pattern, maternal energetics, and maternal age as well as their interaction, in determining duration of lactational amenorrhea in an indigenous population (Toba) resident in northern Argentina.

Field observations indicate that Toba women have an "intense" nursing pattern. They breastfeed their infants on demand, presenting a mean frequency of 0.89 (± 0.52) nursing episodes per hour. Mothers typically introduce solid supplementary food at 6 months of age, although the pattern of intensive breastfeeding continues, and wean their babies when they become pregnant. Toba mothers appear to be well nourished (mean body weight = 62.2 (± 13.3) kg, mean height = 156.3 (± 4.8) cm). Behavioral observations of daily activity patterns suggest that their workload is low to moderate. An analysis of 158 interbirth intervals (IBI, $n = 53$ mothers) indicates that the mean IBI in this population is 24.8 (± 4.8) months.

Data from this study seem to support the "energy balance" hypothesis for explaining the mechanisms involved in the fertility-reducing effects of breastfeeding. Toba women seem to present a positive energy balance, determining a relatively short duration of lactational amenorrhea despite the intense nursing pattern.

Capturing data from three-dimensional surfaces using fuzzy landmarks. C. J. VALERI, T. M. COLE III, S. LELE, J. T. RICHTSMIEIER, The Johns Hopkins University, Baltimore, MD 21205.

Anatomical landmarks are defined as biologically meaningful loci that can be unambiguously defined and repeatedly located with a high degree of accuracy and precision. The neurocranium is characteristically void of such loci. We define a new class of landmarks, termed fuzzy landmarks, that allows us to represent surfaces void of traditional landmarks. A fuzzy landmark represents the position of a biological structure that is precisely delineated, but occupies an area that is larger than a single point in the observer's reference system. In this study, we present a test case in which the cranial bosses are evaluated as fuzzy landmarks. Five fuzzy landmarks (the cranial bosses) and three traditional landmarks were placed repeatedly on three-dimensional (3D) computed tomography (CT) surface reconstructions of dry skulls and skulls of living patients, and directly on four dry skulls using a 3Space digitizer. Thirty landmark digitizing trials from CT scans show an average error of 1.15 mm local to each fuzzy landmark, while the average error for the last ten trials was 0.75 mm, suggesting a learning curve. Data collected with the 3Space digitizer was comparable. Measurement error of fuzzy landmarks is larger than that of traditional landmarks, but is acceptable, especially since fuzzy landmarks allow inclusion of areas that would otherwise go unsampled. The information obtained is valuable in growth studies, clinical

evaluation, and volume measurements. Our method of fuzzy landmarking is not limited to cranial bosses, but can be applied to any anatomical feature with fuzzy boundaries.

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Prelude to paleodiet. Diagenesis among early Holocene skeletons from North India. H. VALLIANATOS, Department of Anthropology, University of Oregon, Eugene, OR 97403

Skeletal series from two early Holocene North Indian sites, Damdama and Lekhahia, are analyzed for diagenetic alteration. This study is the preliminary work required to reconstruct dietary patterns for the people of Damdama and Lekhahia. Because different methods provide information on distinct aspects of diagenetic alteration, multiple methods are used including histological, electron microprobe and trace element analyses. Histological analysis provides information on overall bone integrity, and on alterations due to microbial activity. Because microbes and their metabolic products interact with the skeletal tissue, thus affecting bone chemistry, it is imperative that histological analysis be done before attempts are made to reconstruct diets. Multi-element analysis was done in order to study not only the traditionally used elements in paleodietary reconstructions (strontium, zinc, barium) but also elements that have rarely been utilized (e.g. silver, arsenic, uranium). The study of a broader range of elements provides more precise information on diagenetic and dietary indicators.

This study finds little correlation between histological and elemental analysis, except where diagenesis has progressed to a very large degree. Most specimens were found to be greatly altered under light microscopy. This observation suggests that remaining intact bone of relatively small size can still provide elemental concentrations from which diagenetic and dietary values can be assessed.

Support for this work was provided by the National Geographic Society (awarded to Dr. J.R. Lukacs), the US Department of Energy University Reactor Sharing Grant, and the Graduate School, University of Oregon.

Orangutan cultures? C.P. VAN SCHAIK and C. KNOTT, Biological Anthropology and Anatomy, Duke University and Biological Anthropology, Harvard University.

Manufacture and use of feeding tools in wild orangutans is extremely localized, probably limited to a small

area of swamp forests along the north-west coast of Sumatra. An ecological hypothesis (relying on individual learning as the mechanism for tool use) is unlikely to account for its occurrence. First, the same animals showing tool use in swamp forest also profitably use tools in adjacent hill forest, a widespread habitat type. Thus, orangutans everywhere should be expected to show tool use. Second, the use of tools to extract seeds of *Neesia* sp., a swamp tree, is not found in Gunung Palung in Borneo, even though the seeds are extremely rich in lipids and can be a major component of the diet in the Sumatran swamp for three months.

These findings suggest that, as with chimpanzees, the opportunities for social transmission are the factor limiting the geographic incidence of technology. Hence, like chimpanzees, orangutans have culture (i.e. geographic variation in socially transmitted behaviors), a conclusion supported by at least one other behavior. Preliminary tests support the hypothesis that variation in the opportunities for social learning underlies variation in the geographical distribution of manufacture and use of feeding tools.

It is suggested that tool cultures, once considered apomorphies of the hominid-Pan clade, are in fact synapomorphies of great apes rather than independently derived in both taxa.

Growth velocity variation and disease observed in rural Costa Rican children. K.M. VAN WAGENEN and T.B. GAGE, University at Albany, SUNY, Albany, NY 12222.

The influence of health and disease on growth velocities is a controversial issue. Even in the healthiest of children, the prepubescent growth-velocity deceleration is not a smooth one. This leads to a great deal of discussion over the interpretation of growth velocities in terms of health and disease experiences. This presentation explores the relationship between variation of growth velocity and disease as they are observed in a sample of rural Costa Rican children.

A stratified sample representing the socioeconomic and ethnic diversity, including the indigenous groups, of the rural Canton of Buenos Aires has been selected. Growth velocities of 270 children aged 2 months to 144 months are analyzed. Medical records provide height, weight and medical histories.

In the study sample, growth curves for height based upon cross-sectional data show that both girls and boys

start at or near the 5th NCHS percentile, ascend to almost the 50th percentile by ages 3 and 4 and decline to the 5th percentile by age 8. Longitudinal analyses show growth velocity fluctuations in approximately 12% of the sample. Medical diagnoses of 2597 health care visits include digestive (36%), nutritional (22%), and respiratory (19%) disorders. These and more detailed results will be presented including examination and comparison of illness experiences occurring between growth measurements.

Based upon the similarity of many anthropometric indices, it is expected that the results of this investigation may be applicable to other Latin-American populations as well.

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An analysis of craniofacial variation in *Homo erectus* from Africa and Asia using hominoid analogs. B.A. VILLMOARE, Department of Anthropology, Arizona State University, Box 872402, Tempe, AZ 85287-2402.

Extant hominoids can provide useful yardsticks for establishing the range of variation one might expect to find in hominid fossil species. If the single-species hypothesis for *Homo erectus*-grade hominids is correct, other species of hominoids would be expected to show greater variation than the pooled African and Asian fossil hominid sample.

Three comparative samples of hominoid cranial measurements were used for this study: data from 112 *Pan troglodytes* specimens analyzed by Adolph Schulz, archived at the University of Zurich; 71 *Pan paniscus* crania from Douglas Cramer's 1974 University of Chicago dissertation; and modern human samples from Asia and Africa in W. W. Howell's worldwide study of modern humans. Twelve middle-pleistocene hominids from Africa and Asia made up the *erectus*-grade sample.

Ranges of variation for seven measurements and one index were calculated for *Pan paniscus*, *Pan troglodytes*, and Asian and African modern *Homo sapiens*, and compared to the ranges of variation for the same measurements in the fossil hominid sample. The ranges of variation for the fossil sample revealed intra-specific levels of variation in the pooled *erectus* sample for the measurements used in this study. Additionally, histograms for the pooled hominoid data showed species-specific polymodal distributions, unlike the pooled *erectus* sample, which revealed no specific or geographic modality.

Due to this limited variation in the fossil sample, the single-species hypotheses cannot be rejected. The single-species conclusion is underscored by the fact that the African ape samples represent species that inhabit much smaller geographic areas than did *Homo erectus*, yet demonstrate comparable or greater variation.

Prehistoric treponematoses in the western United States. P.L. WALKER, Department of Anthropology, University of California Santa Barbara, CA 93106, and P.M. LAMBERT, Department of Sociology, Social Work, and Anthropology, Utah State University Logan, Utah 84322

Examination of over one thousand prehistoric and protohistoric Native American burials from coastal California and the American Southwest reveals clear evidence for treponemal disease in western North America. The earliest well-documented examples come from SBA-52, a 4300-year-old cemetery on the edge of an ancient estuary in the Santa Barbara Channel area. These burials have a relatively high frequency of periosteal lesions (37% of individuals affected) and show clear histological signs of treponemal disease. Other Santa Barbara Channel area collections also show signs of treponematoses, but there is considerable temporal and spatial variation in the frequency of skeletal lesions. On the mainland coast, skeletal lesions are most common at early sites such as SBA-52. On the Channel Islands, in contrast, they are relatively rare in early remains, and peak in frequency between A.D. 500 and 1300. During this period of climatic instability, the tibias of about 27% of the burials exhibit lesions possibly associated with treponemal infection. Although rare, the cranial lesions considered pathognomonic of syphilis are present in both island and mainland skeletal collections.

Skeletal series from the American Southwest also exhibit lesions characteristic of treponematoses and show a pattern of skeletal involvement strikingly similar to that of contemporaneous Santa Barbara Channel area remains. The skeletal manifestations of treponemal disease in these arid-land samples contrast in both frequency and severity with those of contemporaneous samples from humid regions of the southeastern United States. This suggests the possible role of climate as a factor contributing to variation in the physical manifestations of treponemal disease.

A survey of skeletal remodeling in the mammalian skeleton: a pilot study. R.A. WALKER, New York Chiropractic College, Seneca Falls, NY 13148-0800

Mammalian skeletal remodeling is a complex phenomenon. Among other factors, it may be affected by imposed mechanical loads which may vary from location to location within the skeleton. To quantify such variation, and preparatory to a larger study using modern human skeletal material, the limb bones from the dry skeleton of a single young adult domestic cat (*Felis domesticus*) were examined. Bones included in the analysis were the left and right femora, tibiae, humeri, radii and ulnae. Each bone was transversely sectioned at 9

points at intervals of 10 % of the bone's total length. Thin sections were made at these locations. Cross-sectional properties were calculated for each section, including: area moment of inertia about the AP axis (Iap); about the ML axis (Iml); polar moment of inertia (J); cortical area; and total cross-sectional area. Numbers of primary osteons, secondary osteons, fragmentary secondary osteons, and percent haversian bone were determined for each section. Comparisons of these parameters were made between proximal and distal limb segments, between serially homologous fore- and hindlimb bones, and between contralateral members of pairs of bones. Proximodistal variation within bones was also examined. Preliminary results indicate increasing amounts of remodeled bone near the midshaft, with reduced amounts of remodeled bone toward proximal and distal metaphyseal regions and little side-to-side variation in histomorphology or geometric properties.

Obviously the locomotor anatomy of the cat varies significantly from that of *Homo sapiens*, and loading environments for the human fore- and hindlimb are substantially different from that of a cursorial quadruped. However, it can be expected that the *types* of variation present in the appendicular skeleton of the cat will also evince themselves in the human skeleton.

No living animals were harmed or sacrificed. This research is supported in part by a grant from the Research Department at New York Chiropractic College.

Methods for the analysis of forest structure in studies of primate positional behavior. S.E. WALKER, Humboldt State University, Arcata, CA 95521, and D.J. BERGESON, Washington University, St. Louis, MO 63130.

Arboreal primates face many locomotor and postural challenges when traveling and feeding in their complex arboreal environment. Forest structure and strata have long been recognized to influence the positional behavior and choice of supports for arboreal primates. Therefore, it is important to quantitatively analyze forest structure as well as positional behavior. Particularly important is the documentation of aspects of forest structure that are related to challenges of arboreal movement and the availability of arboreal pathways.

In this paper we present a methodology for measuring forest structure that we feel is simple, unbiased, particularly applicable to studies of primate positional behavior, and allows for comparison among research sites. We present this methodology as part of a case study of two Costa Rican forests: Santa Rosa National Park in the northwest and La Suerte Biological Field Station in the northeast. Data were collected on circumference, height, peripheral crown contact and climber density within plots located using stratified random sampling. Significant differences were observed between the sites, particularly for measurements of peripheral crown contact and climber density. These differences in forest structure are interpreted in terms of their potential influence on primate positional behavior.

Sex differences in weight prediction from the femur and sacrum. D. WALRATH, Department of Anthropology, University of Pennsylvania, Philadelphia, PA 19104

Accurate estimation of female weight is critical for reconstruction of reproductive behavior and biology of fossil hominines. The articular surfaces of weight bearing joints are the most logical estimators of weight as they have a direct biomechanical relationship to body mass. The finding that male weight is more reliably estimated from femoral measures than female weight has been attributed to greater variability in percentage of fat among females. Evaluation of sacral vs. femoral measures as estimators of weight can help distinguish whether *pelvic dimorphism*, rather than *body composition*, accounts for sex differences in weight prediction. In the former case, measures of the sacrum should have a similar correspondence to body weight in both males and females, while the relationship of femoral diameter to body weight would be expected to differ between the sexes.

Measurements of the femur and sacrum were taken from computed tomographic images of individuals with known weight and height (n=100 females, 103 males). Results confirm earlier reports that femoral measures are significantly better predictors of weight in males compared to females (male $r^2 = .47$, $p < .001$; female $r^2 = .07$, $p = ns$). Sacral body area, in contrast, did not show sex differences in its ability to predict weight (females $r^2 = .25$, $p < .01$; males $r^2 = .29$, $p < .01$). Regression equations using the pooled sex sample form a single regression ($r^2 = .45$, $p < .01$) model with more explanatory power than one constructed from males and females individually.

These findings suggest that the relatively greater breadth of the female pelvis attenuates the correspondence between femoral measures and weight in females. Given that wide pelvic breadth is a plesiomorphic feature in hominines, an understanding of the effects of pelvic breadth on weight estimation is critical to weight estimation in paleoanthropological reconstruction of reproduction.

New postcranial fossils of *Australopithecus afarensis* from Hadar, Ethiopia. C. V. WARD, M. S. DRAPEAU, University of Missouri, Columbia, MO 65211, W. H. KIMBEL and D. C. JOHANSON, Institute of Human Origins, Arizona State University, Tempe, AZ 85287.

Thirty new postcranial specimens attributed to *Australopithecus afarensis* were discovered at Hadar, Ethiopia, during the 1990-1994 field seasons by a team from the Institute of Human Origins and the Ethiopian Ministry of Information and Culture. These fossils, ranging in age from younger than 3.4 to younger than 3.0 mya, provide important new information about the locomotor skeleton of this species.

Among these new fossils is a nearly complete right talus (A.L. 333-147), part of a new series of fossils from the prolific A.L. 333 locality. It is the first known from a large *A. afarensis* individual. Although the diminutive

A.L. 288-1 talus shares much of its morphology with human tali, its trochlear surface is more tightly curved, and its talocrural joint is inferred to have had an enhanced range of motion, more similar to the chimpanzee than the human condition. A.L. 333-147 has a flatter trochlea than does A.L. 288-1, and when paired with comparably-sized *A. afarensis* tibias, probably had a more limited range of talocrural joint motion. These data support the hypothesis that body size, not locomotor differences, explains this aspect of variation in hominin tali.

Another new specimen is A.L. 438-1, which, along with cranial fragments, includes an associated complete ulna, partial humeral and radial shafts, and metacarpals 2 and 3. These are the first associated forearm and hand remains of *A. afarensis*, providing an opportunity to assess upper limb proportions in this species.

Also recovered was the first lunate known for *A. afarensis*; a large, blocky bone that resembles a lunate from the 3.5 myr site of South Turkwel, Kenya. In addition, a new proximal femur from Hadar bridges the gap in size between smallest and largest *A. afarensis* femora, consistent with the hypothesis that only one hominin taxon is present in pre-3.0 myr levels at Hadar.

Other fossils include a large, robust humeral shaft, a last lumbar vertebral body from a large individual, a partial thoracic vertebra, other vertebral fragments, five phalanges, two metacarpals, a proximal and distal femur from one subadult individual, and proximal and distal tibias. Taken together, these fossils increase our understanding of the postcranial anatomy, function and variation in *Australopithecus afarensis*.

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Prenatal long bone growth and proportionality in fetal abortus and stillborns. M.W. WARREN, Department of Anthropology, University of Florida, Gainesville, FL 32611.

Normalization procedures that eliminate size effects show that all human groups correspond to a general species-specific pattern of growth. Modifications in the rate and timing of growth events provide a direct measure of a group's developmental response to the environment. Comparison of the linear growth of the long bones has been shown to be an effective way of demonstrating genetic and secular differences between populations. Most skeletal growth studies, however, have been directed toward the postnatal period. Prenatal studies have generally been clinically oriented and are poorly suited for adaptation by anthropologists working with skeletal populations.

This study analyzes the linear growth and proportionality of the long bones for a sample of 398 fetuses based on radiographic measurements of diaphyseal length and recorded crown-heel length (CHL). The data are derived from the full-body radiographs of stillborn and spontaneously- or therapeutically-aborted fetuses delivered near sea level between 1976 and 1988 in the southeastern United States. Additional data on crown-heel length, sex, self-identified "race," and pathology are taken from associated autopsy records. Earlier studies based on skeletal samples fail to adequately assess the impact of various soft-tissue pathologies on relative growth and proportionality of the skeleton.

Growth distance curves are plotted using crown-heel length as a normalizing datum to eliminate size effects. The sample is divided into 10 groups of CHL measurements, roughly corresponding to gestational ages

from 4.5 lunar months to term. Descriptive statistics for each long bone are provided. The correlation between radiographic lengths of long bones and crown-heel length is established and relative and absolute growth of the long bones examined in terms of relative increase in percent and linear incremental increase. This method of illustrating long bone growth, introduced by Armelagos, et al. (1972), is used because of its simplicity, and because continuity of analytical methods is desirable if a better understanding of human variation is to be achieved. The data from the current study are compared with the data of Fazekas and Koza's (1978) eastern European study in order to establish its applicability as a normative sample for fetal analysis in North America.

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Polymorphic aspects of canine honing among Old World anthropoid males. A. WASHBURN, Temple University, Philadelphia, PA 19122.

Previous studies of the canine/premolar complex based on quantitative measures of size and shape suggest that anthropoid C1's and P3's are polymorphic and can not be accommodated within single morphological types. From this it can be expected that canine honing mechanisms show polymorphic aspects that reflect the functional demands placed on the respective occlusal partners.

Assessments were made of C/P occlusal relationships among males in 32 Old World anthropoid taxa by examining the amount of P3 enamel available for canine honing (i.e., PEV or premolar enamel volume).

Separate regressions of PEV on body mass and canine projection for all OW anthropoids indicated that great apes and gibbons have PEV's which differ from expectations. The OW monkey regression equation of PEV on BM generated predictions for great apes and gibbons which were far in excess of their observed values. The OW anthropoid regression of PEV on CPROJ indicated that great apes and gibbons had some of the greatest positive and negative residuals, respectively, and suggests that canine projection alone is not the best predictor of PEV for some taxa. The OW monkey regression equation of PEV on CPROJ generated PEV predictions which were lower than the observed values for great apes, but higher for gibbons (great apes canines are stout while gibbon canines are long and slender). This is not surprising, since CPROJ overlooks canine basal crown dimensions such as length, and, in particular, breadth, which may be more highly correlated with PEV than is CPROJ.

These findings further support the claim for polymorphic aspects of the anthropoid C/P complex and may contribute to our understanding of the loss of this dental complex in the human lineage.

A biocultural overview of the W. Montague Cobb Skeletal Collection: Towards a biological and social history of a late 19th to mid 20th century urban population. R.J. WATKINS, University of North Carolina at Chapel Hill, NC 27599-3120.

The focus of this poster is the W. Montague Cobb Skeletal Collection, which primarily consists of African Americans employed as day laborers and domestics in the Washington, D.C. area. Unclaimed by families for burial, these individuals were obtained for the establishment of a research collection at Howard University between 1932 and 1969. One hundred individuals from the collection (49 women and 51 men), obtained between 1933 and 1937, are used to present a biocultural overview of this population. The variables occupation, cause of death, pattern of degenerative joint disease (DJD), and residential address are used to gain an understanding of this population's overall quality of health, socio-economic status, and degree of 'marginality.'

Chi-square and Spearman's correlations are calculated to determine the extent of the relationship between DJD patterns and labor for individuals of known occupation (n=61). The frequency of DJD in individuals for which occupation is documented is also compared to those for which it is not, in addition to comparing the differences in frequency between men and women. Cause of death, which is documented for 76 individuals, is surveyed to determine diseases of greatest prevalence in the population.

This study reveals that the sample characteristics relating to quality of life -- namely poor health, high levels of mechanical demand and low standard of living -- are consistent with other low socio-economic groups in urban settings of North America.

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Chimpanzee male aggression and sexual coercion at Ngogo, Kibale National Park, Uganda. DAVID P. WATTS, Dept. of Anthropology, Yale University, New Haven, CT. 06511.

Sexual coercion is use by a male of (threat of) force that increases his chances of mating with a fertile female, and decreases the chances of other males, at some cost to the female. Chimpanzee males use multiple mating tactics, including mate guarding by single males or by coalitions of males, consortships, and promiscuous mating by multiple males with single females. Estrous females commonly receive aggression from males, especially during mate guarding and during some attempts at consort formation. Descriptions of this aggression figure prominently in theoretical discussion of sexual coercion, but few relevant quantitative data are available from wild chimpanzee populations.

I provide detailed data on the rate and intensity of male aggression to females for wild chimpanzees at Ngogo, Kibale National Park, Uganda. The data

allow comparison of male behavior towards individual females in and out of estrus, and towards females when they mated promiscuously versus when they were subject to mate guarding. I also examine variation among males in aggression rates and copulation success. Individual females were targets of more male aggression, and of more intense aggression, both absolutely and per male/female pair hour, when they were in estrus than when they were anestrus. This was especially the case when males were trying to mate guard females. The rate at which males directed aggression at estrous females was positively related to male copulatory success. This is as expected if the aggression constituted sexual coercion, but the correlation may have occurred because aggression rate was positively correlated with male rank, while rank in turn was positively correlated with copulation success. Circumstantial evidence is consistent with the prediction that male aggression imposes costs on females, although no measure of cost is yet available. I outline a method to test this prediction more formally with behavioral and endocrinological data.

Treponematoses in the prehistoric Caribbean, North Carolina coast and Kentucky: paleoepidemiological and evolutionary perspectives. D.S. WEAVER, Wake Forest University, Winston-Salem, NC 27109, M.K. SANDFORD, G. BOGDAN and G.E. KISLING, University of North Carolina at Greensboro, Greensboro, NC 27412.

The antiquity of treponematoses in the New World is no longer in question. Now, our emphasis should shift to the paleoepidemiology and evolution of New World treponematoses. This paper is a preliminary discussion of probable modes of transmission, disease interactions, host and pathogen characteristics, disease manifestations, and likely consequences of treponematoses.

There is a long history of discussion of the evolutionary dimensions of treponematoses. Some of these discussions are problematic. Modern diagnostic labels often are applied to prehistoric conditions. Disease-host co-evolution often is not fully considered, while an appreciation of the evolutionary context of the disease often is lacking. Frequently, the specific characteristics of the disease are overlooked.

Using our examination of three prehistoric New World skeletal samples, we offer our conclusions concerning the paleoepidemiology and evolutionary aspects of the New World treponematoses.